Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of claims:

1-89. (Cancelled)

90. (Original) A method for coupling a system comprising a superconducting qubit and a resonant control circuit, wherein an interaction term of a native interaction Hamiltonian that describes an interaction between said superconducting qubit and said resonant control circuit has a diagonal component, the method comprising:

(A) applying a recoupling operation a first time to the superconducting qubit;

(B) tuning, for an amount of time, the resonant control circuit so that a resonant frequency of the superconducting qubit and a resonant frequency of the resonant control circuit match; and

(C) applying the recoupling operation a second time to the superconducting qubit, thereby transforming the interaction term of the Hamiltonian to have only off-diagonal components.

91. (Original) The method of claim 90, wherein said applying the recoupling operation (A) and wherein said applying the recoupling operation (C) comprises implementing a Hadamard gate on the superconducting qubit.

92. (Original) The method of claim 91, wherein the Hadamard gate comprises the sequence $Z(\pi/2)$-$X(\pi/2)$-$Z(\pi/2)$, wherein $X(\pi/2)$ is a single qubit σ_x-based operation and $Z(\pi/2)$ is a single qubit σ_z-based operation, and said σ_x-based operation and said σ_z-based operation are each applied over a phase evolution of $\pi/2$.

93. (Original) The method of claim 90, wherein said tuning (B) comprises setting a first energy spacing between a first energy level and a second energy level of the resonant control circuit so that the first energy spacing corresponds to a second energy

spacing between a first energy level and a second energy level of the superconducting qubit.

94. (Original) The method of claim 93, wherein said setting said first energy spacing is effected by changing a bias current associated with said resonant control circuit.

95. (Original) The method of claim 90, wherein a plurality of quantum states of the superconducting qubit are respectively entangled with a corresponding plurality of quantum states of the resonant control circuit during said amount of time.

96. (Original) The method of claim 90, wherein the resonant control circuit is characterized by an inductance and a capacitance.

97. (Original) The method of claim 96, wherein said inductance is tunable.

98. (Original) The method of claim 90, wherein the resonant control circuit comprises a current-biased Josephson junction.

99. (Original) The method of claim 98, wherein said tuning (B) comprises changing a current bias across the current-biased Josephson junction.

100. (Original) The method of claim 99, wherein said tuning (B) comprises changing a current bias across the current-biased Josephson junction by 1 micro-Ampere or less.

101. (Original) The method of claim 99, wherein said tuning (B) comprises changing a current bias across the current-biased Josephson junction by 100 nanoAmperes or less.

102. (Original) A method for entangling a state of a first qubit and a state of a second qubit in a system comprising (i) said first qubit, (ii) said second qubit, and (iii) a resonant control circuit, wherein said first qubit, said second qubit, and said resonant control circuit are each respectively coupled to a bus and wherein an interaction term of a native interaction Hamiltonian that describes an interaction between at least one

of said first qubit and said second qubit with said resonant control circuit has a diagonal component, the method comprising:

(A) applying a recoupling operation to at least one of said first qubit and said second qubit, wherein said recoupling operation transforms said interaction term so that it has only off-diagonal components;

(B) tuning, for a first amount of time, the resonant control circuit so that a resonant frequency of the first qubit and a resonant frequency of the resonant control circuit match;

(C) tuning, for a second amount of time, the resonant control circuit so that a resonant frequency of the second qubit and a resonant frequency of the resonant control circuit match; and

(D) reapplying the recoupling operation to said at least one of said first qubit and said second qubit.

103. (Original) The method of claim 102, further comprising;

(E) tuning, for a third amount of time, the resonant control circuit so that a resonant frequency of the first qubit and a resonant frequency of the resonant control circuit match.

104. (Original) The method of claim 102, wherein said first qubit is capacitively coupled to the bus and said second qubit is capacitively coupled to the bus.

105. (Original) The method of claim 102, wherein the resonant control circuit is in electrical communication with the bus.

106. (Original) The method of claim 102, wherein said applying (A) comprises implementing a Hadamard gate on the at least one of said first qubit and said second qubit.

107. (Original) The method of claim 106, wherein the Hadamard gate comprises the sequence $Z(\pi/2)$-$X(\pi/2)$-$Z(\pi/2)$, wherein $X(\pi/2)$ is a single qubit σ_x-based operation and $Z(\pi/2)$ is a single qubit σ_z-based operation, and each σ_x-based operation is applied

over a phase evolution of $\pi/2$ and the σ_z-based operation is applied over a phase evolution of $\pi/2$.

108. (Original) The method of claim 102, wherein said tuning (B) comprises setting a first energy spacing between a first energy level and a second energy level of the resonant control circuit so that they are approximately equal to a second energy spacing between a first energy level and a second energy level of the first qubit.

109. (Original) The method of claim 108, wherein said setting the first energy spacing comprises changing a bias current associated with the resonant control circuit.

110. (Original) The method of claim 102, wherein said tuning (C) comprises setting said first energy spacing so that it is approximately equal to a third energy spacing between a first energy level and a second energy level of the second qubit.

111. (Original) The method of claim 110, wherein said setting the first energy spacing comprises changing a bias current associated with the resonant control circuit.

112. (Original) The method of claim 102, wherein a plurality of quantum states of the first qubit is respectively entangled with a corresponding plurality of quantum states of the resonant control circuit during said first amount of time.

113. (Original) The method of claim 102, wherein a plurality of quantum states of the second qubit is respectively entangled with a corresponding plurality of quantum states of the resonant control circuit during said second amount of time.

114. (Original) The method of claim 102, wherein the resonant control circuit is characterized by an inductance and a capacitance.

115. (Original) The method of claim 114, wherein the inductance is tunable.

116. (Original) The method of claim 102, wherein the resonant control circuit comprises a current-biased Josephson junction.

117. (Original) The method of claim 116, wherein said tuning (B) and said tuning (C) comprises changing a current bias across the current-biased Josephson junction.

118. (Original) The method of claim 116, wherein said tuning (B) and said tuning (C) comprises changing a current bias across the current-biased Josephson junction by 1 micro-Ampere or less.

119. (Original) The method of claim 116, wherein said tuning (B) and said tuning (C) comprises changing a current bias across the current-biased Josephson junction by 100 nanoAmperes or less.

120. (Original) The method of claim 102, wherein said first qubit is superconducting.

121. (Original) The method of claim 102, wherein said second qubit is superconducting.

122. (Original) The method of claim 102, wherein said resonant control circuit is superconducting.